

COMMENTS ON TRIP TO U.S.S.R. UNDER S&T
AGREEMENT, SEPTEMBER 17 - OCTOBER 12, 1975

STATINTL

D. D. Aufenkamp - *Computers in Management*

The purpose of the trip was three-fold:

1. Completion of the definition of a cooperative program on Topic 5, "Computer-aided Refinement of Decision-making of High-level Executives."
2. Meetings of the Joint Commission.
3. Meetings with the Soviet Working Group Chairman and other topic coordinators.

I. Topic 5 Delegation

1. Although the Soviet side appeared to have been stalling over the past year or two on Topic 5, the organization for the visit of this delegation was very thorough. As with the Topic 4 delegation in June, the host organization sent individuals from Moscow to each city visited in advance to ensure that arrangements were in order. (See report on trip of Topic 5 delegation for a detailed account of visits and impressions. Included, too, is a partial listing (annotated) of materials received.)
2. Two members of the five-member U.S. delegation had to cancel at the last minute, one due to family illness and the other due to pressure of business. The Soviet side appeared disappointed initially at the small size of the delegation but this reaction seemed to disappear after the first day or two.
3. The high productivity of the meetings was due in part to the personal interest of key professors at several of the institutes visited. Two of the Soviet subtopic coordinators, Professor Syroyezhin of the Leningrad Institute of Economics and Finance and Professor Ozira of the Moscow Institute of National Economy have spent about a year each in the U.S.--Syroyezhin at Cornell and Ozira at the Harvard Business School. Both worked particularly hard in developing the detailed program.
4. Soviet presentations were thorough and detailed. The preparation of the substantive program to be included in the protocol illustrates this point. U.S. and Soviet participants worked intensively from 10:30 a.m. to midnight on a Saturday with time out only for a late lunch on developing the joint statement of the program.

State Dept. declassification & release instructions on file

FILE 01.01-Computer Applications
S+T

CCS
OSI
OER
CRS
ATS
4 mil
file

12 APR 1976

-2-

5. The Soviet Topic Coordinator, Dr. N. N. Ivashchenko, was particularly forceful in emphasizing to Soviet participants in meetings that it was necessary to formulate concrete projects for the cooperative program. Dr. Ivashchenko will continue to provide overall policy guidance but Dr. Popov of the Economics Department of Moscow State University will provide technical direction.
6. The U.S. side had proposed a list of about 15 institutions and organizations to visit in connection with formulating the scientific program. The Soviet itinerary included the principal U.S. requests and, in addition, several other institutes and organizations previously unknown to the U.S. delegates but of particularly high quality and interest for the U.S. delegation and the cooperative program.
7. In Leningrad, we did not visit the Management Training Institute of the Ministry of Ship Building which was on the itinerary given to us. The schedule was particularly tight in view of the long discussions at the Institute of Economics and Finance--but it is my impression also that no one had made any contacts with this training institute. We did have good meetings with Management Training Institutes in both Tallinn and Riga, however.
8. The visit to the Tallinn Excavator Factory apparently presented some difficulties in that the factory was under the Ministry of Heavy Equipment and permission for the visit was not obtained until nearly the last minute. We understood that calls were placed by our Soviet escorts to both the Ministry of Heavy Equipment and the State Committee for Science and Technology and that then on the strength of a telephone call, the Director of the factory received us (without a written confirmation). We had emphasized strongly to our Soviet hosts when told the visit might not materialize that visits to selected enterprises were an essential part of the trip.
9. The itinerary indicated we would visit an unspecified factory in Riga. Our escort from Moscow indicated in Tallinn that this was to be a radio factory but that again they were having difficulties in getting permission. In fact, we did not go and the Riga Polytechnical Institute was substituted. We did not protest this change after having succeeded in Tallinn to visit one enterprise. (On our return to Moscow we also had a good meeting at the ZIL automobile (truck) factory.) On the last afternoon in Riga our Soviet hosts arranged what they called a "surprise" for us--a visit to the Riga Wholesale Trade Office of Central Union and Latvian Union of Cooperative Societies. This was a wholesale/retail distribution center which was most interesting to the U.S. delegation.

-3-

10. The visit to the Institute of Management of National Economy also seemed particularly fruitful to us. This Institute we believe is a very important one to have participating in the cooperative efforts in view of its unique role in the U.S.S.R. for training of high-level executives.
11. The original itinerary indicated we would be traveling by train from Moscow to Leningrad. Thus we did not have air tickets for this portion. For some reason the Soviet side decided to send us by plane and while we indicated we should be paying for the intercity transportation, our Soviet hosts paid for the plane tickets.

II. Joint Commission Meeting

1. I prepared the joint report on the activities of the Working Group in the Application of Computers to Management. Dr. Ramayev had a few comments but none which resulted in material changes. He accepted, as did the Joint Commission, the need to develop long-term joint efforts to follow on the seminars and workshops.
2. Dr. Stever discussed with Dr. Kirillin privately the U.S. reaction to the Soviet postponement of the mathematical economics seminar and the problems of rescheduling it as well as the Soviet postponement of the large city delegation scheduled to meet in the U.S. In the Joint Commission meeting, Dr. Kirillin commented, following my report, that he understood there were problems in scheduling meetings and asked Dr. Rameyev to meet with me the following week to work out arrangements to reduce the probability of future postponements.
3. In my meeting later with Dr. Rameyev, he said that Soviet participants in the economics modeling seminar had been given a maximum of two months to complete their papers and that the Soviet side would be prepared to go ahead with the seminar in December. The Soviet side, according to Rameyev, was translating the Soviet papers into English. I explained that the U.S. participants would not all be able to get together again before June 1976. Dr. Rameyev agreed to check with the Soviet participants and then cable me (confirmation of the week of June 14 received December 9).
4. A visit was arranged to the Experimental Research Institute of Machine Cutting Lathes in connection with the Joint Commission meetings. A report on that meeting is attached (Attachment 1).

-4-

III. Meetings with the Soviet Working Group Chairman, Other Topic Coordinators and Visits to Other Institutions.

1. Visits were arranged to the following institutions during the week following the Joint Commission meeting:

Moscow Institute of Electronic Machine Building

Institute of Electronic Control Machines

Institute for Information Transmission Problems

Reports on each of these visits are attached (Attachments 2, 3, and 4).

2. Meeting with Modin (Soviet Coordinator - Topic 1: Econometric Modeling). I met with Modin, Suvorov and Ioffe (who had just returned from the U.S.) in connection with the Topic 5 delegation and again one evening at dinner. The proposed meeting to discuss several items in the September protocol, which were to have been taken up at the mathematical economics seminar, did not materialize due to the U.S.S.R. Academy of Science celebrations. Modin indicated that they were very impressed with Harvey McMains' efforts during the visit to the U.S. and would extend him an invitation for a week at the Central Economics Mathematics Institute if McMains would be interested. (McMains will probably go in April)
3. Meeting with Bezrukov (Soviet Coordinator - Topic 2: Large Systems) and Shekhovtsov (Assistant to Lebedinsky). The meeting was, in part, for the purpose of discussing several items that were to have been taken up by McMains during the mathematical economics seminar. The publication of the proceedings of the transportation seminar was one item. The Soviet understanding was that we were to agree on titles and then the papers could be exchanged. (I am not sure why there would have to be agreement on titles and the U.S. papers had been handcarried to the State Committee for Science and Technology in June.) It is expected that the Soviet papers will be received by December and the U.S. will also send revisions of the U.S. papers at that time.

In regard to follow-on activities to the transportation seminar, the U.S. side had sent Bezrukov a proposal earlier in the summer. Bezrukov responded that Kosin, Director of the Institute of Complex Transmission Problems would formulate specific proposals in reply.

-5-

We had also previously sent Lebedinsky and Bezrukov a proposal for longer-term joint activities at GOSPLAN. Bezrukov said these were being considered but were too vague for a meaningful response. I suggested that the Soviet side propose more specific project activities within the general framework provided by McMains and we, in turn, could respond to this. He agreed to have GOSPLAN's Economic Research Institute formulate a more specific proposal.

3. Meeting with Morozov (Acting Topic Coordinator - Topic 4: Software), Roslyakov (Deputy Director, Moscow State University Computer Center) and Baraboskin (State Committee for Science and Technology). Professor Shurakov was on leave and I met with Morozov (also of the Moscow Institute of Economics and Statistics). Morozov, although associated with Topic 4 participated in many of the Topic 5 meetings in September (he went with us to Leningrad). Except for the interaction between Topics 1 and 2 due to Lebedinsky's coordination there has been little interaction between the topics on the Soviet side.

The purpose of the meeting was to ascertain Soviet preparations for implementing the program endorsed the preceding week by the Joint Commission and, in particular, to prepare for the workshop on mathematical software scheduled for December in the U.S.

The Soviet side was prepared to send a delegation in December to keep their commitment to the workshop but Baraboshkin indicated that they would be able to send only one group in 1975 (the protocol called out other possible exchanges). The delegation would probably consist of Morozov, Roslyakov, Baraboshkin and Arushanian (who is already in the U.S. under an IREX program). Suggestions for visits included MIT, Stanford, University of Illinois (Bitzer and Gribble - structural linguistics).

My impression from remarks of Baraboshkin was that the Soviet side was not going to be able to support all the activities proposed in the June protocol. Rameyev, however, had stated in June that the program was an ambitious one and other activities might have to be cut in order to support these (I may have misunderstood and he may have indicated that some of the Topic 4 activities might have to be curtailed). Volkovitsky, during discussions in formulating the Topic 5 program, also stressed that he had the job of allocating resources for the support of S & T activities and he gave me the impression that priorities would have to be made. The Soviet side indicated, however, that it was prepared to receive U.S. experts in accordance with the stipulations of the protocol.

-6-

4. Meeting with Rameyev on Topic 3. Tkachenko was said to be away and his assistants were reluctant to meet with me as spokesmen for the joint effort. I met then with Rameyev to discuss problems on Topic 3. Rameyev had agreed earlier to the U.S. suggestions to reschedule the visit to November 30 and he reiterated this confirmation. Volkovitsky had told me earlier in the week that the delegation could not come in 1975 (It, in fact, did not show up on the scheduled flight on November 30.) Volkovitsky had also told me that Leningrad was out and Riga was being considered. I brought this also to Rameyev's attention and he said Leningrad was still in (We subsequently received material on Leningrad.)
5. Meeting with Rameyev on Working Group Activities. Rameyev and I also discussed several aspects of improving the effectiveness of our work including communications and scheduling. In regard to communications, the present arrangements of contacts via the State Department and by direct means seems to be working reasonably well. It was indicated that if Dvoretz was not available by telephone, then cable was probably the next best alternative.

The project plan for next year is complex due to the five topics with several activities in each. Rameyev volunteered to develop the first draft of a "master" plan which would serve as a basis for discussion next year.

6. Other comments and observations. There have been several successes during the past year--but a few hang-ups, too. The postponement of the economic mathematics modeling seminar a week before it was scheduled indicates a lack of appropriate project management on the Soviet side notwithstanding the statement that they have taken the seminar seriously.

The efforts of the U.S. side to provide high-quality substantive meetings for Soviet groups in the U.S. has been, I believe, a strong factor in Soviet efforts to do the same in regard to the meetings held in the U.S.S.R. in April, June, July and September of 1975. I must emphasize strongly the value of the close personal interaction in the cooperative efforts in the application of computers to management (and probably in other areas as well). It is my impression that my visits to the Institute of Electronic Machine Building (where I was told that I was the first U.S. visitor) took additional efforts on the part of my Soviet hosts.

-7-

This trip was also useful in trying to obtain a better understanding of the Soviet bureaucracy in regard to the computer applications area. It was suggested that attempts are being made to arrange visits to places that have not been visited previously by U.S. delegations. Approval is not always obtained, and if so, often at the last minute. I had requested visits to a software group in Kalinin and Moscow Institute of Electronics at Zelenograd which did not materialize. Apparently no Americans have been to either. It was suggested that a visit to the Institute of Electronics at Zelenograd would be difficult because of its emphasis on communications. I was told, however, that I was the first American to visit the Institute of Electronic Machine Building.

I also learned that Rameyev did not acquire the doctorate through the usual academic program but was granted the degree on the basis of his work in designing the Ural computer series.

Trip Report of U.S. Delegation on "Computer-aided Refinement of Decision-making and Education of High-level Executives" to U.S.S.R., September 18-30, 1975.

(Issued as separate report)

ATTACHMENT 1

October 3, 1975, Moscow

Visit to Experimental Research Institute of Machine Cutting Lathes
(HMIC) (accompanied by K. E. Volkovitsky)

I met only with Oleg Nikolavich Tatur, Deputy Director. The interpreter was provided by the institute. (Her usual work was in written translations from English to Russian and she was not strong in spoken English especially in describing some of the highly technical procedures.) The institute is under the Ministry of Machine Tools and Small Tool Industry. The institute serves only the machine tool building industry. The Deputy Director, Tatur, was I believe also in charge of the research division of the institute responsible for computer techniques in economics and technical production.

The main activities stem from a research base for new design of various types of metal cutting machine tools. Examples included guideways for spindles, low friction bearings, gear boxes. There is much work on numerically controlled systems and also developments in metrology including very accurate measuring devices and some control devices. The institute is responsible for developing standards for machine tool building for all of the U.S.S.R. It is also concerned with the problems of forecasting in the area of metal working and machine tool building. Another concern is that of tests and documentation. This general overview function was said to be useful in reducing duplication.

The institute has its own experimental plant associated with the institute. The institute has about 2000 people of which about two-thirds were said to be scientists and technicians. There are 1600 people at the plant.

Much attention is given to problems of geometry, particularly complex problems. They have special programming languages for the complex languages but these languages were developed at other organizations. The main efforts were described as directed towards the specialization of programming languages to solve technological problems. One of the software packages being used was a variation of APT obtained from West Germany. The systems are being developed for medium class machines like the Minsk 32 and the ES 1020.

It was mentioned that the institute has a contract with IBM to supply a 370/158 system during the 3rd quarter of 1976.

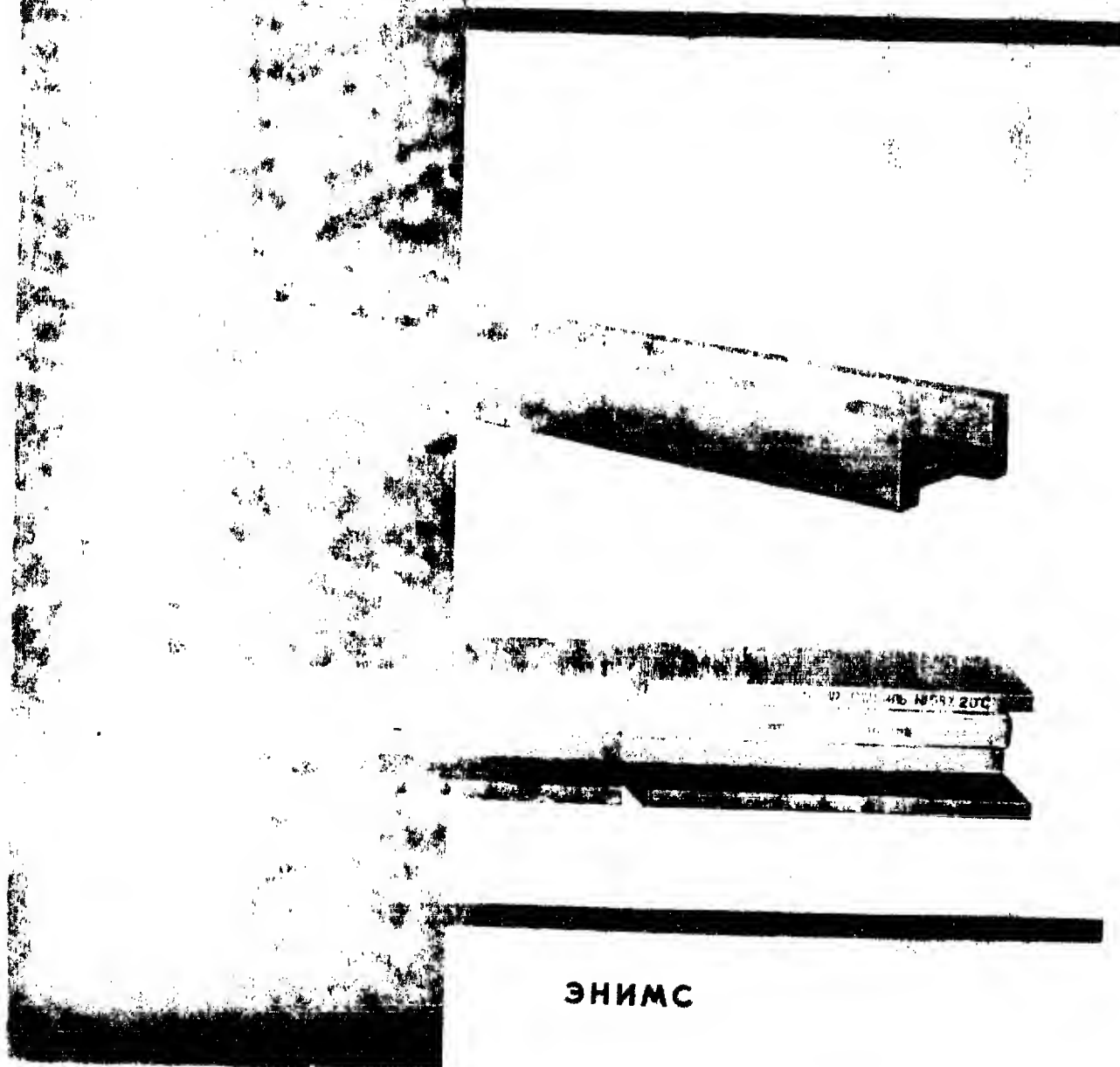
I visited the experimental research laboratory, the test facility building, the controlled temperature laboratory and the computer center.

-2-

1. Experimental research laboratory. This laboratory was devoted to developing advanced techniques for making dies, molds, etc. Four techniques were being tried: spark, ultrasonic, electrochemical and laser as well as combinations of the four. Under the spark technique if, for example, a die was to be made, a small hole would be drilled through the material in which a wire would be inserted. An associated power source would supply an electrical impulse with the cutting being controlled by a mini-computer. I saw one experimental set up in operation. The cutting was done under water and was controlled on-line with a mini-computer. The electrochemical techniques were said to be useful for complex patterns in molds. Many prototypes were in the area--a mold for a boot being one example. The laser techniques were said to be applicable for example to making the many small holes needed in watch components. The laboratory gave the appearance of being active with several technicians at work.
2. Test facilities. This was a building that was described as one used for testing complete assemblies of machine tools. There was a work area where several technicians were at work. Most of the equipment awaiting tests was of Soviet origin but some was described as being of East German origin.
3. Controlled temperature laboratory. This facility was located three floors underground. The main room was controlled to within 0.2 degree centigrade. No special precautions were taken on access to the room. A small laboratory controlled to .005 degree centigrade was, by contrast, completely insulated by about a foot of air space and was on springs. Controls on humidity were not mentioned. Much work was done here on standards of lengths with lines engraved on bars of special alloys. Units were in both the metric and English systems. A brochure on the work of this laboratory is attached.
4. Computer Center. The facilities were well laid out although some remodeling was in progress. (For some reason I was taken in through a back door--ordinarily blocked off--connecting to the experimental research laboratory.) A Minsk 32 was at this facility. The ES 1020 was located elsewhere. The principal use of the machine was described as the development of scientific programs for numerically controlled tools. There is a small group of application programmers associated with the center but for the most part it was said that the engineers do their own programming.

*BEST COPY
Available*

ШТРИХОВЫЕ МЕРЫ ДЛИНЫ ОСОБО ВЫСОКОЙ ТОЧНОСТИ



ЭНИМС

Металлические штриховые меры длины особо высокой точности широко применяются во всех отраслях промышленности, служат основой точных измерительных систем в станках, конторах и машинах, в качестве образцовых мер объектов хранения единицы длины и передачу размеров другим средствам измерения.

Образцовые штриховые меры применяются для контроля при изготовлении штриховых мер на делительных машинах с фотоэлектрической системой;

для аттестации штриховых мер на компараторах;

для аттестации ходовых винтов, червяков, винтовых пар на измерительных машинах;

для аттестации точности перемещений в станках, машинах, приборах.

Образцовыми штриховыми мерами длины комплектуются метрологические лабораторные мини-стерилизаторы и предприятия, измерительные лабораторные заводы.

Штриховые меры длины особо высокой точности МС38-01-а (ТВ2-024-3891-74), применяемые как

образцовые, изготовляются в 0-1-го классах точности по ГОСТ 12302-66 и аттестуются 1 и 2 м разрядом. Отклонение расстояния штриха на длине 1000 мм нормируется в пределах 1 мкм для 0-го класса и 2 мкм для 1-го класса точности. Отклонение расстояния λ (в мм) любого штриха на длине l (в мм) определяется по формуле:

$$\lambda = (0,5 + 0,5/l) \text{ для 0-го класса;}$$

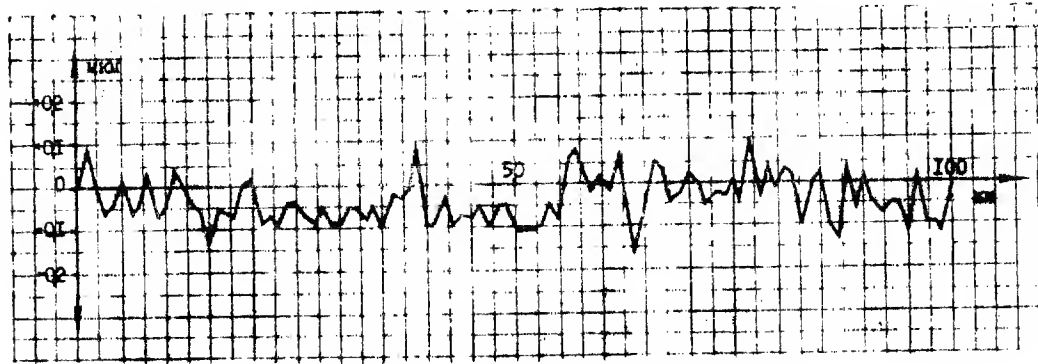
$$\lambda = (1 + 1/l) \text{ для 1-го класса.}$$

Штриховые меры МС38-01-а сопровождаются аттестатом на отклонение расстояния каждого миллиметрового подразделения от нулевого штриха.

При заказе штриховой меры необходимо указывать полное наименование изделия, номер технического условия, количество изделий, отраслевое обозначение (МС), индекс изделия (38-01), длину и расчетной части штриховой меры (см. таблицу), класс точности штриховой меры (0; 1).

Пример заказа:

Образцовая штриховая мера
ТВ2-024-3891-74, 1 шт МС38-01-1000-0.



ОПИСАНИЕ ШТРИХОВОЙ МЕРЫ

Штриховые меры МС38-01-а изготовляются из сплава 58Н1 (ЭН1792), содержащего 58% никеля. Коэффициент линейного расширения сплава (ТКЛП) равен $11,5 \times 10^{-6} \text{ град}^{-1} \text{ } ^\circ\text{C}$ в интервале температур 20-100°C.

При изготовлении штриховые меры проходят сложную механическую обработку с многократными стабилизирующими термическими операциями. Форма поперечного сечения штриховой меры Н-образная, причем шкаловая поверхность расположена в нейтральной плоскости сечения.

Штриховые меры при эксплуатации устанавливаются на опорах в местах наименее деформируемых точек (точки Бесселя), и в этом случае шкаловая поверхность, расположенная в нейтральной плоскости сечения, испытывает минимальный прогиб под действием гравитационных сил.

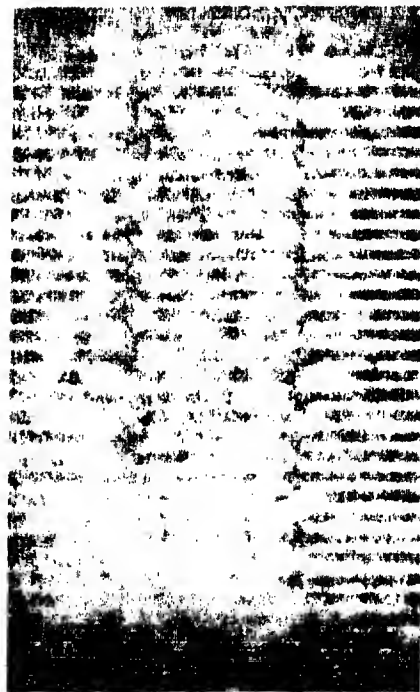
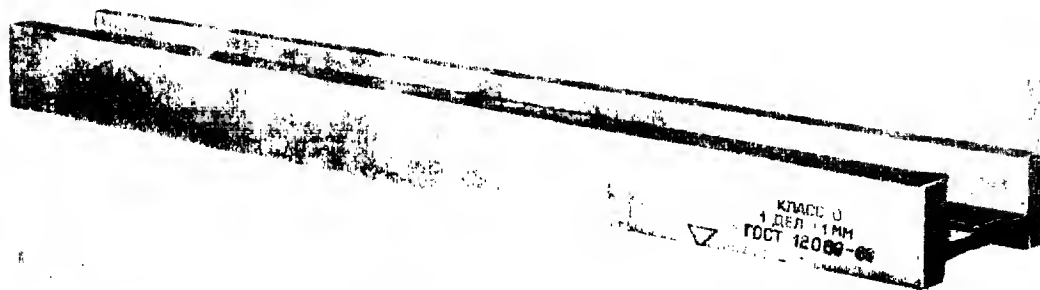
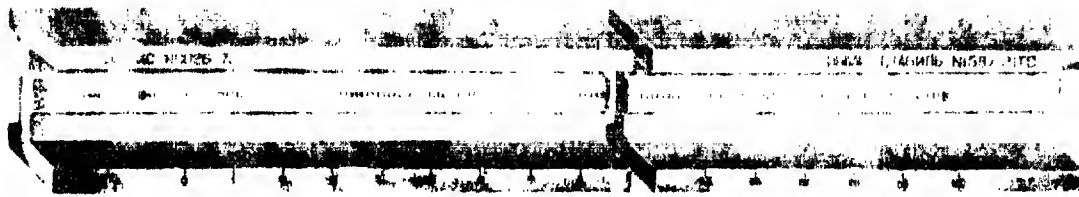
На шкаловой поверхности нанесены: основная шкала с интервалом 1 мм на общей длине от 100 до 1000 мм (см. таблицу); две дополнительные шкалы с интервалом 0,1 мм на длине 1 мм;

две осевые линии с расстоянием между ними 0,3 мм.

Дополнительные шкалы используются для аттестации внутримиллиметровых подразделений (или перемещений) и для юстировки оптических устройств.

Участок шкаловой поверхности, ограниченный двумя осевыми линиями, является рабочей зоной штриховой меры.

Высокие требования предъявляются к форме и расположению шкаловой поверхности. Так, для штриховой меры с общей длиной 1050 мм 0-го и



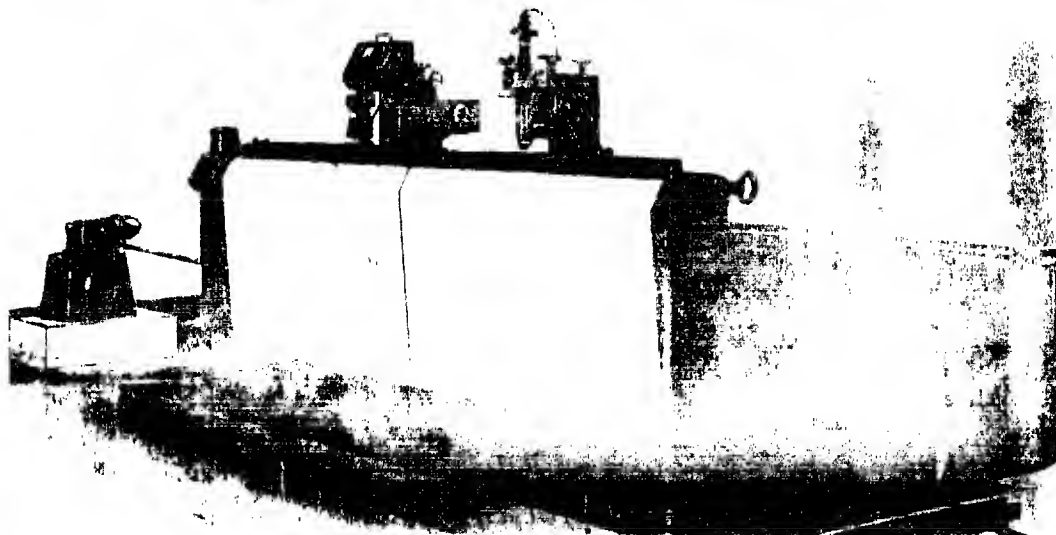
Это классов точности оптические шкаловой поверхности от произвольности и параллельности в продольном направлении составляет 0,006 мм.

Металлические штриховые меры рассматриваются в отраженном свете для воспроизведения штриха и используются микроскопистом с освещением через объектив.

Важное значение имеет шероховатость и состояние шкаловой поверхности, ее оптическое качество. В рабочей зоне шкалы нормируется количество местных дефектов, химических включений.

В штриховых мерах МС 48.01 достигнуто высокое качество самого штриха, который наносится двугранным алмазным резцом. Двугранный угол штриха, сформированный алмазным резцом, выбран таким образом, что лучи отраженные от граней штриха, не возвращаются в объектив микроскопа, в результате чего на ярко освещенной шкаловой поверхности штрих воспринимается как контрастная черная полоса.

На интерференционном картине, возникающей при наблюдении штриха мерой с помощью интерференционного микроскопа, хорошо видны высокие качества штриха, подтверждающие точность его граней.



Нанесение штрихов и аттестация расположения штрихов на штриховых мерах МС38-01 а осуществляют на уникальных делительных машинах и компараторах, разработанных ЭНМСом и изготовленных в ЭНМСе и на заводе «Станкоконструкция»

Делительные машины МС18М и МС40, оснащенные фотоэлектрической позиционирующей системой копируют исходную штриховую меру, с поправкой погрешности расположения штрихов исходной меры.

Погрешности расположения штрихов, внесенные на аттестата исходной меры, кодируются на перфокарте и вводятся в позиционирующую систему машины



Аттестации ведутся на компараторах, оснащенных отчетной фотоэлектрической и лазерной интерференционной системой — позиционирующим фотоэлектрическим микроскопом

ЭНМС располагает специальным термостатическим помещением, в стенах которого на виброизолирующих фундаментах размещаются компараторные машины для проверки и аттестации образцовых штриховых мер длины

ГОСТАНДАРТом СССР ЭНМСу как базовой отраслевой лаборатории предоставлено право аттестации штриховых мер длины 1 и 2 го разрядов



УСЛОВИЯ ЭКСПЛУАТАЦИИ

Для нормальной эксплуатации образцовых штриховых мер необходимы следующие условия:
 температура 20°С (ГОСТ 9249-59);
 относительная влажность воздуха от 40 до 60%;
 чистота воздуха:
 размеры частиц пыли не более 0,3 мкм;
 количество пылинок, оседаемых на 1 см² стекла в 1 час, не более 40;
 установка штриховой меры на опорах в местах наимыгоднейших точек (см. указатели на боковой плоскости меры);
 отсутствие вибрации.

Разные виды работ требуют дополнительных ограничений температуры от $\pm 0,2^\circ$ до $\pm 0,05^\circ$ С (подробно см. инструкцию по эксплуатации образцовых штриховых мер длины. Инструкция входит в комплект документов, поставляемых со штриховой мерой МС38-01).

В общем случае требуется обеспечить выравнивание температуры (с точностью $\pm 0,05 \pm 0,1^\circ$ С) машины, прибора, измеряемой (поверяемой) и эталонной меры, воздуха рабочей зоны.

Краткая техническая характеристика
 образцовых штриховых мер длины МС38-01-а ТУ2-024-3891-74

Тип штриховой меры	Длина нарезаемой части штриховой меры, мм	Общая длина штриховой меры, мм	Углы штрихов в поперечном сечении, град	Размеры поперечного сечения штриховой меры, мм
I	100	130	51±30' 72'	
	125	155		
	160	190		
	200	230		
	250	280		
	300	330		
II	320	350		
	400	440	120'	
	500	540		
	630	670		
	700	740		
III	800	840		
	1000	1050		

Материал	Нивар-стабиль 5811 (ЭП1792) ТУ 14-1-949-74	Момент инерции поперечного сечения меры, см ⁴	1,41
Величина наименьшего подразделения основной шкалы, мм	1	Масса одного погонного метра меры, кг	2,96
Величина наименьшего подразделения дополнительной шкалы, мм	0,1	Отклонение от номинального значения расстояния любого штриха меры (ГОСТ 12069-66), мм:	
Ширина штриха в поперечном сечении, мм	0,005 ± 0,001	для 0-го класса	0,5 ± 0,5 l
Шероховатость шкаловой поверхности, R _a , мкм	0,032	для 1-го класса	1 ± 1 l
Площадь поперечного сечения меры, см ²	3,57	(где l — номинальное значение расстояния между штрихами в мм)	

ЭДК 401.01.000-1

Т.000.01

Лак. 2197/000

ИНПМАШ

Номинальный размер интервала	Отклонения	Номинальный размер интервала	Отклонения	Номинальный размер интервала	Отклонения	Номинальный размер интервала	Отклонения
мм	мм	мм	мм	мм	мм	мм	мм
1	+ 0,1	51	- 0,1	101	- 0,1	151	- 0,1
2	0	2	- 0,1	3	0	3	0
3	- 0,1	4	0	4	+ 0,1	4	0
4	0	5	- 0,1	5	+ 0,1	5	0
5	0	6	+ 0,1	6	0	6	0
6	- 0,1	7	0	7	- 0,1	7	0
7	0	8	0	8	0	8	0
8	0	9	0	9	0	9	0
9	- 0,1						
10	- 0,1	60	0				
11	0	1	0				
12	0	2	0				
13	0	3	0				
14	- 0,1	4	- 0,1				
15	0	5	0				
16	- 0,1	6	- 0,1				
17	0	7	0				
18	- 0,1	8	0				
19	0	9	0				
20	0	70	0				
21	- 0,1	1	- 0,1				
22	0	2	0				
23	- 0,1	3	- 0,1				
24	0	4	0				
25	0	5	0				
26	- 0,1	6	- 0,1				
27	0	7	0				
28	- 0,1	8	0				
29	0	9	0				
30	- 0,1	80	0				
31	0	1	0				
32	- 0,1	2	- 0,1				
33	0	3	0				
34	- 0,1	4	- 0,1				
35	0	5	0				
36	- 0,1	6	- 0,1				
37	0	7	0				
38	0	8	0				
39	+ 0,1	9	0				
40	- 0,1	90	0				
41	0	1	0				
42	- 0,1	2	- 0,1				
43	0	3	0				
44	- 0,1	4	- 0,1				
45	0	5	0				
46	- 0,1	6	- 0,1				
47	0	7	0				
48	0	8	0				
49	0	9	0				
50	- 0,1	100	0				

Министерство государственной и инструментальной промышленности СССР
 Экспериментальный научно-исследовательский институт
 металлообработки и машиностроения
 НИИИМС
 Отдел метрологии

АТТЕСТАТ

ШТРИХОВАЯ МЕРА ДЛИНЫ

Общая длина, мм	1000	Изготовлена (наименование организации)	3 НИИМС	Представлена на аттестацию (наименование организации)	3 НИИМС
Наименьшее подразделение основной шкалы, мм	0,1				
Материал	Инвар-стабиль			Аттестация проведена	3/1-1975 г.
Назначение	Сред. выпуска			Срок действия аттестата	до 3/1-1977 г.
Образцов	1975				

На компараторе (МС-351) поверена (сличением с исходной штриховой мерой * 0037, аттестованной ВНИИ им. Д.И. Менделеева 25/5-1974 г. с предельной погрешностью $\pm 0,03$ мкм и $3\sigma = \pm 0,09$ мкм при температуре $20^\circ\text{C} \pm 0,05^\circ\text{C}$ и установке меры на опорах в местах наимыгоднейших точек.

РЕЗУЛЬТАТЫ ПОВЕРКИ

1. Отклонение общей длины меры	$\pm 0,1$ мкм
2. Наибольшее отклонение расстояния между двумя любыми штрихами	0,5 мкм
3. Наибольшее отклонение расстояния между соседними штрихами	0,2 мкм
4. Класс точности по ГОСТ 12089-66	2
5. Предельная погрешность аттестации \pm	0,2 мкм

Результаты аттестации приведены на 5 листах

Примечание

Исп. отделом метрологии
 Исп. лабораторией измерений
 Старший инженер

ATTACHMENT 2

October 7, 1975, Moscow

D. D. Aufenkamp

Visit to Moscow Institute of Electronic Machine Building (accompanied by K. E. Volkovitsky, SCST).

I met with the rector, Evgeny V. Armensky, and two vice rectors, the vice rector for science (and head of the Chair for Design of Computers) E. D. Pozhidaev and the vice rector for education, V. N. Afanasyev (both vice rectors were young). The interpreter was Irene Pivovarova, an instructor in the Foreign Language Department. Volkovitsky said I was the first American to have visited the institute.

The institute is only 14 years old. Its objective is to train specialists in computer building, particularly in the design, development and use of computers. There is training for the design of computers and other machines. There is a special thrust in electronic circuitry including the circuit components of computers. The institute is not large but is considered the best one in Moscow. It is housed in two principal buildings (said to be about 20 minutes apart).

There is a strong emphasis on mathematics and physics during the first two years, more than is given at other institutes. For example, about 450 hours of mathematics instruction and 350-375 hours of physics instruction is given at other institutes. At the Institute of Electronic Machine Building, 700 hours of mathematics instruction and the same physics instruction plus 100 hours of the physical basis of electronic techniques are given. The lectures are usually given by Doctors of Science. There are 20 Doctors of Science in Mathematics and Physics and a total of 50 in the institute. There are 300 staff members holding the Candidate degree. In addition to the undergraduate work, both Candidate and Doctorate degrees are given at the institute and contrary to the usual practice in the Soviet Union, the Scientific Council need not be consulted in awarding Candidate degrees.

There are 3600 day students and 2500 evening students (small in comparison with the student population at other institutes we have visited). About 15-20 students are kept from each graduating class for work at the institute or to work on advanced degrees. Industry was said to want 600 specialists per year but only 20 per year were available from the institute. There are approximately 500 students currently working on the Candidate degree. Of the student body, 42% are women.

-2-

There is much emphasis for both students and faculty on high quality science research. Scientists work at the institute; there is a special science research department; and students also take part. After the third year nearly all students are active in research work. There is a Student Design Bureau which was described as the best in the USSR. (It won first prize this year). The bureau gets tasks from industry and was described as being of much help to industry. (Breznev was said to have spoken of student achievements at a recent all union meeting of students). Last year, one student won a gold medal of the Academy of Sciences (five are given per year). There were said to be a total of 815 institutions of higher education in the U.S.S.R. Entering students have grade point averages of about 4.46/5.

The computing facilities include two ES 1020's, two Minsk 32's, Minsk 22's, ten MIR 1 and 2 machines, five NAIRY's and four ODRA (of Polish origin, single address computer similar to the Minsk 32). There were many analog computers and many of the PDP 8 class. There are two functions for the computing facilities: one function is as a service facility for those doing research for industry and the other is for training students. Use is also made of machines at other places for service work. (In the first course on programming and programming languages, there is a month of training on computers at the institute and elsewhere). The computer facilities are also used for administrative purposes--student records, for example.

Faculty at the institute publish about 25-30 text books per year. A faculty member spends about 6 hours per day (6 day week) as a professor including 2-2 1/2 hours per day with students and about 3 hours per day on contract research from enterprises, for which extra salary is received (not less than 300 hours per year must be devoted to industrial work).

Visits were made to several classrooms, laboratories and the Computer Center. Professor Popov, Head of the Chair of Cybernetics has seven groups of students of about 25 each. His responsibilities included applied mathematics--software and use of computers, automation. In the 5 1/2 years of training, students receive a good background including early training in language, special training in algorithms, formal grammars, programming and operating systems. Languages taught include ALGOL and ALGOL-like languages, FORTRAN, COBOL, PLI and Assembly languages. In the 4th and 5th year SIMULA is taught. An ODRA and MIR II computers were associated with Popov's labs.

Professor Titour's laboratory was devoted to circuits. She was of several women said to be on the staff. Most of the equipment was analog with oscilloscope output. The usual plug boards were in evidence for student use. Some students were at work solving a circuit design problem.

-3-

Several other laboratories and facilities were also visited. One laboratory was equipped with a NAIRY computer and character display with light pen. Another laboratory was devoted to work on automation and telemechanics. It was equipped with a MIR II computer (it was available 20% of the time for student use). Another laboratory with two NAIRY computers was used for studies in the theoretical cybernetics. An example was given of a problem of diagnosing an illness in which students would prepare data for use in a mathematical model. Still another lab laboratory, equipped with a MIR II computer, was described as being devoted to man-machine systems. One lab was for analog equipment and the machine was described as having 25 integrators. The laboratory for Computer Techniques was equipped with an ODRA 1204 (they have 4). This lab was used mainly for science research work.

The Computer Center was equipped with an ES 1020 and a Minsk 32 computer. The director said he would like an ES 1040 with time sharing. The 1020 was being upgraded, as I understand to a 1022 which was said to be about 10 times as fast as the 1020 due to new circuitry.

Volkovitsky proposed that I give a lecture at the institute on developments in the U.S. on the use of computers in training specialists. The proposed date was Friday, October 10 but the lecture did not materialize due, it was said, to the death of Bogomolov of the Ministry of Higher Education which precluded some of the principal faculty from attending.

ATTACHMENT 3

October 9, 1975, Moscow

D. D. Aufenkamp

Visit to Institute of Electronic Control Machines (Complex Computer Control Institute or Soviet Business Cards) MHEYM. Moscow, V-133, Vavilova, 24. (accompanied by K. E. Volkovitsky, SCST)

Met with:

Boris N. Naumov - Director, Doctor of Engineering, Professor,
Deputy Chairman, USSR National Committee of
Automatic Control

Eugene N. Filinov - Deputy Director (in charge of software)

Boris Tamm - Director, Institute of Cybernetics, Tallinn

Valentin P. Cēmuk - Mathematics

- Representative of Protocol Department

Naumov provided some general background on the Institute. The institute was founded as an institute of the Academy of Sciences and branched off from the Power Institute. It is under the Ministry of Instrumentation Systems and Means of Automation and Control Systems. It has the prestige of being the institute where the first computers were built in the 1950's and 1960's--the M 3 and M 22 computers. Professor Brook was the designer. (He died recently.) The first computers built in mainland China were the one designed by Rameyev (perhaps the Ural computer) and one from this institute. The institute was strongly characterized as one working for industry.

There are three principal thrusts at the institute:

- I. problems of control computers
- II. systems applications
- III. mathematics and software

The staff number is 1500 and there is an associated factory for building prototypes with a staff of 2000. The factory also produces a few items that were designed elsewhere.

-2-

- I. The research on computers at the institute concerns medium class machines:
 1. The M 4000 and M 4030 were designed at the Kiev factory with all software handled here. The machines are mass produced and the software is up to date.
 2. The small-scale M 400 control computer was designed here and is mass produced in Kiev. It is used mainly in applications to science research and real time problems. It has a "uni-bus" base.
 3. The M 40 is a centralized control computer designed at the institute and also mass produced in Kiev.
 4. They are also building integrated systems as in the U.S. and West Germany.
 5. A 4th generation computer is under design.
 6. A specialized computer system to find faults in electronic circuits.

The director discussed a possible cooperative project to develop compatible standards--of interfaces, languages, control instructions, etc. He mentioned negotiations with Digital Equipment Corporation on buying a license from DEC for such efforts in connection with the PDP 11. (There is a PDP 11 at the institute). The U.S. government was said to have turned down the request.

II. Systems Applications

Historically, the work in systems applications has been concerned with power system control based on machines like the M 400 and M 40. There is more emphasis in recent times on the use of smaller computers (previously the emphasis was said to have been on the use of large machines). Other systems applications include:

- Mass spectrometer and applications in physics research (there had been an exhibition last year of computers in process control).
- Automation and power distribution systems. The first part was commissioned for the Southern part of the power grid. It used an M 4030. The software included many hundreds of 1000's of bytes.

- Inventory applications - information and retrieval systems.
- Social security system for the Moscow region.
- Uzbek system for the Zeravshan valley that will optimize the use of water resources.

III. Mathematics and Software

The principle areas of work included:

- Operating systems: integrated software systems for the M 4030 and M 400.
- Software work with data bases (integrated systems).
- Automation of design.
- Software for fault finding in electronic circuits.

The long-term research of the institute was described as consisting of:

1. Research on magnetic bubble memories.
2. Software research to improve effectiveness of magnetic bubble techniques.

Visits were made to the computer center and three laboratories. The principal machines in the computer center were two M 4030 computers with 2 micro second memory and 512 K bytes of high speed memory. The machine was said to perform 100,000 operations per second on the Gibson mix #1. There are linking the two systems - memory, channel, etc.--to work in a hierarchical system with small computers. Other machines include an M 400 with 32 K bytes of memory (about one rack of hardware for the machine configuration seen), a PDP-11 configuration (several racks) and a Siemens 45 (System 4004) computer system (said to be copied after the RCA Spectra 70 series). I believe the PDP-11 was linked to the Siemens.

There were said to be about 350 application programmers.

One of the laboratories was concerned with automation of design--tracing of printed circuits, wiring tables, documentation. There was a flat-bed printer tracing out the design of a printed-circuit board.

Another laboratory was concerned with research in magnetic bubble memories. The head of the laboratory is Dr. Raev who had spent some time at Yale University working with Barker. Raev's papers have been published in the IEEE Transactions on Magnetics which reported on the conference of magnetism and magnetic materials in December 1974.

The material used in the research on magnetic bubble memories was formerly Orthoferrite (RFeO_3). (A small sample of the material was given to me.) Now they are using $\text{R}_3\text{Fe}_5\text{O}_{12}$. I viewed a sample of a bubble memory through a microscope which showed three bubbles moving within a grid network. (I believe the field of vision was said to be but 50 angstroms in diameter.) The movement of the bubbles was initiated and stopped by a switch on the laboratory monitoring device.

The expectation was to have a memory of 10^6 bits in a crystal about the size of 1 by 2 by .5 centimeters. It was estimated, too, that an operating memory would be available by 1980 with possibly a prototype operating in conjunction with an existing computer before that time.

In another laboratory, this one under the direction of a Dr. Rosenthal, logic circuits were being constructed with the magnetic bubble technology. They had gone beyond the simple "and" and "or" gates and I saw, again under the microscope, one representing an impulse function. The estimate of Rosenthal was that such circuits could be incorporated into a prototype machine by 1978.

In a general discussion with Filinov on software development it was noted that groups are developing specialized software. Also many students do their "practical" work at the Institute and then come back for post-graduate work. (I believe that on the order of 100 students were said to be at the institute each year.)

In a concluding discussion, Naumov mentioned several possible cooperative projects. He stressed the need to achieve concrete mechanisms for helping industry. Possible projects included:

1. A joint project with a university for developing a prototype magnetic bubble memory for use in mini-computers.
2. Joint efforts on developing compatible standards for instruction sets, etc. He repeated the example of trying to enter into a license agreement with Digital Equipment Corporation.
3. Joint effort to develop standards for algorithms and languages for mini-computers. The work of Ted Williams at Purdue University (who apparently began with FORTRAN) was mentioned.

-5-

4. Research on mini-computers with "soft" architecture. The work of a professor at Stanford who reported on his work at the recent National Computer Conference at Anaheim was cited. Included might be recommendations on technical policies.
5. Small meetings of leading scientists from both countries on special topics. For example, the Academy of Science is interested in increasing the effectiveness of science research. If compatibility of Soviet and U.S. mini-computers were achieved (the PDP-11 was again mentioned), then it would be possible to conduct a series of interesting seminars on software systems applications.

The Director and others were unusually forthright in their enthusiasm about wanting to develop cooperative projects with the U.S. The Director noted particularly that he felt that the Institute could participate on an equal basis scientifically contrary to reports that he had heard that any science and technology projects between the U.S. and U.S.S.R. would constitute a one-way transfer of technology to the U.S.S.R. I noted Dr. Stever's response to a similar query at the press conference in Moscow. I noted also that it would probably be easier and quicker to develop cooperative projects within the context of the approved topics under the Computer Applications Working Group than to try to formulate a new area of cooperation.

ATTACHMENT 4

October 10, 1975

D. D. Aufenkamp

Visit to Institute of Problems of Information Transmission (accompanied by K. E. Volkovitsky)

I met with the prorector. The institute is a part of the U.S.S.R. Academy of Sciences. It is concerned primarily with investigations of problems of a fundamental nature in the transmission of information. There are 11 laboratories in roughly two parts: physics-mathematics and biological. In all there are about 300 scientists. A brief description of each laboratory follows.

1. In the physics-mathematics laboratory the base is Shannon's theory. Other topics include coding theory and methods, sequential coding after algorithms of Zygunderov and Jelenic. There has been much work in the field of feedback coding and real-time channels which represent extensions of Shannon's work. There are several projects on coding for computers to improve the reliability of communications. Attention is given, too, to the complexity of coding and decoding, for example, the relationships between the number of computations and the number of elements.

Another branch is mathematical statistics--estimation of stochastic processes and control of random processes.

2. Biological laboratory under Lebedev. The emphasis is on image processing. Previously there were efforts on data compression and characteristics of visual reception. Now more attention is given to images (removing noise) especially in work on cosmic data processing for the space program. Processing includes color and black and white as well as non-linear. There is also work on computer holography--the preparation of holograms obtained by lasers and processed by computer. This lab has an ALPA 16 mini-computer manufactured by Computer Automation.
3. Pattern recognition laboratory under Turbovich. The principal attention is on visual images--handwritten, faces, speech. An example was work on identifying a portrait of deVinci--a portion of the painting "Secret Meeting in Evening" (it had been suspected that St. Bartholomew was the actual painter). They started from a self portrait of deVinci when he was old and applied reverse transformations to the facial features and by comparisons concluded that the St. Bartholomew painting was actually a self-portrait of deVinci.

-2-

In the second field of research, that of speech control they have developed a vocabulary of about 100 important words that can be recognized by a device under computer control. Apparently other control mechanisms are also studied--the power grid in the western U.S.S.R. was mentioned.

4. Mathematics laboratory under Dobruchkin. The emphasis seemed to be on coding theory. They had obtained results on perfect and quasi perfect codes. There was work on reliable coding in the environment of unreliable elements. There was much interesting work on random systems of the Markov type--for example communications nets. An example was given of a simple graph with a fixed probability of independent failure in an edge. A threshold of failure exists in which below the threshold there is a high probability of the graph remaining connected and above the threshold a low probability of connection.
5. Laboratory under Kharkovich. Two fields are stressed: (1) queuing theory with particular applications on communications networks and (2) systems of switching circuits on a communications node.
6. Laboratory under Lazorov. The work here concerned the control of information flow in communications nets, particularly, dynamical methods of control. There was much work on algorithmic developments, for example, an optimal flow. The structure includes subalgorithms where automata at nodes have only limited information on neighbors. An analogy in visual patterns would be the construction of mountains and valleys with the algorithm representing the path of a free-wheeling particle. Other problems concerned asynchronous automata.
7. A laboratory under Pinsker had two divisions (1) the computing center of the institute (2) research on computer-aided medical diagnosis. They have a Minsk 22 and Minsk 32 computers. The computer-aided diagnosis is based on cardiograms. One experiment concerned the distribution of electrical potentials of the heart. The original investigation was made on a model of a human body with a simulated heart (dipole). The rotation and shifts of the dipole changed the distribution of potentials on the surface of the body. Later experiments were conducted on the live heart of a dog. As a result they have developed algorithms of heart disease diagnosis and can do this remotely via telephone circuits. Other algorithms have been developed to assist physicians in diagnosing potential hemorrhages.

-3-

8. Laboratory under Bysev. The focus here is on data processing in visual receptors of man and animals. There is an emphasis on both the scientific and educational aspects. Investigations were conducted on the role played by several different types of cells in eyes referred to as slow and fast "bipolars" in which several layers of the retina were investigated. Techniques of microelectrodes were developed in which the use of the microelectrodes would not harm the cells. Techniques were also developed of keeping a human eye alive while isolated in order to study eye movements while "seeing". They have also developed some highly original microsuction cups to study eye movements which were described in Scientific American.

Other studies concern insect behavior. Color vision and identification of geometric patterns have been studies using honey bees (it is believed that honey bees can distinguish between circles and triangles). The behavior of animal is investigated. For example, a frog "sees" a fly as a spot and not as a fly. A frog's nervous system is in two parts--an analog system (close to the retina) for fast reaction and a discrete system.

9. Laboratory under Garfinckel. Studies of control of movements of man and animals are carried out. One application area is the design of movable devices to aid invalids. An artificial hand was developed controlled by electrical currents. Experiments on cats involving relationships between externally applied electrical impulses to a portion of the brain and muscular movements were also described.
10. A laboratory on mathematical methods in biology (temporarily without a leader) was concerned with problems as the propagation of impulses through heart muscles and the brain considered as a neural network.
11. A laboratory under Alexeyev was concerned with studies of motion and controlled movement on a higher level, for example, studies of causes and faults in human movement through encephalograms. A separate laboratory will soon be formed which will be concerned primarily with problems of the transmission of electrical impulses through membrane.

The building in which the visit took place was one of several buildings--the others being located elsewhere. Only mathematicians and statisticians were located here and thus there were no laboratories of special interest to see.

I met briefly with Dima Stefanyk of the Institute on October 12 before leaving Moscow. I had met Stefanyk at the International Conference on Artificial Intelligence in London a few years ago and again in the U.S. during a six-month visit he made here. Stefanyk was one of the Soviet organizers of the Artificial Intelligence Congress in Tbilisi in September 1975. His impressions about the Congress was that while there had been some problems along the way most were cleared up to the satisfaction of most people.